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(54) Structure of lip drive portion of T-die.

(57) A lip drive structure for a T-die including a main body structure member (1) having an elongated nozzle orifice defined by a pair of lip portion (14) facing each other, a nozzle structure portion (12) including one of the lip portions and formed at the lower end of the main body structure member (1) so as to be integrally connected to the same through an elastically deformable portion (11), a plurlity of bellows (2) disposed on a side surface of the main body structure member (1) on the side of the nozzle structure portion (12), and a drive section structure member (3) fastened to the bellows (2) at its upper portion and fastened to the lip structure portion (12) at its lower portion. Air supply holes (10) are formed in the drive section structure member (3) to enable the bellows (2) to be supplied with compressed air. The drive section structural member (3) is divided into a plurality of elements (3a, 3b, 3c) in the longitudinal direction.

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STRUCTURE OF LIP DRIVE PORTION OF T-DIE

BACKGROUND OF THE INVENTION

This invention relates to a structure of a lip drive portion of a T-die.

For lamination processes in which a base formed of paper, aluminum foil or plastic is coated with a resin, systems for controlling the coating thickness to improve the quality of worked products as well as to reduce the amount of resin required are in increasing demand. For realization of such systems, development of a T-die in which the rate at which a molten resin flows out can be controlled is an important technical theme.

Conventionally, the rate at which a molten resin flows out of a T-die is adjusted by manually rotating gap adjusting bolts provided in association with the lip portion of the die. Types of drive systems such as a heat bolt system and a servo motor system have been adopted for automatization of this adjustment. The heat bolt system is based on the utilization of thermal expansion of bolts. In this system, however, the time required to perform heating or cooling is long and the responsiveness of the drive system is therefore considerably low. The servo motor system is based on an idea of using a robot system instead of the conventional manual operation. In this system, one or a plurality of motors are used to successively rotate bolts. However, it is not possible to drive all the bolts simultaneously, resulting in an increase in the adjustment time.

SUMMARY OF THE INVENTION

In view of the problems of the conventional art, an object of the present invention is to provide a T-die having a lip drive structure in which the gap can be adjusted at a high speed and with accuracy.

In accordance with the present invention, there is provided a lip drive structure for a T-die comprising: a main body structure member having an elongated nozzle orifice defined by a pair of lip portion facing each other; a nozzle structure portion including one of said lip portions and formed at the lower end of said main body structure member so as to be integrally connected to the same through an elastically deformable portion; a plurality of bellows disposed on a side surface of said main body structure member on the side of said lip structure portion; a drive section structure member fastened to said bellows at its upper portion and fastened to said nozzle structure portion at its lower portion; and air supply holes formed in said drive section structure member to enable said bellows to be supplied with compressed air.

Compressed air can be supplied through the air supply holes of the drive structure member to the interior of the bellows to expand the bellows and to apply a moment from the drive section structure member to a nozzle portion through a nozzle structure member, thereby displacing the nozzle portion. The drive section structure member is divided with the split grooves formed therebetween, thereby enabling the respective drive sections to be operated without interference between adjacent drive sections.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view of a T-die lip portion;

Fig. 2 is an illustration as viewed in the direction of the arrow II in Fig. 1;

Fig. 3 is an illustration as viewed from the bottom of Fig. 2;

Fig. 4 is a cross-sectional view taken along the line IV - IV of Fig. 2;

Fig. 5 is an illustration of the deforming operation of a drive section; and

Fig. 6 is a diagram of a pressure-displacement characteristic of a lip portion.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Fig. 1 shows in perspective a lip portion of a T-die to which the present invention is applied. The T-die essentially consists of three types of components: a main body structure member 1, a plurality of bellows 2 disposed over one side wall of the main body structure member 1, and a drive section structure member 3 which connects the bellows 2 and a lip portion 14. In this combination, the number of drive sections can be selected as desired.

Fig. 2 is a diagram as viewed in the direction of the arrow II of Fig. 1, Fig. 3 is a bottom view of Fig. 2 and Fig. 4 is a cross-sectional view taken along the line IV-IV of Fig. 2. The bellows 2 are fastened and fixed to the main body structure member 1 by means of bolts 8 and are also fastened and fixed to the drive section structure member 3 by bolts 7. Seals 4 and 5 (Fig. 4) are disposed at fastened portions of the bellows 2 to prevent leaks of compressed air in the bellows 2.

The main body structure member 1 has an elastically deformable portion 11 and a nozzle structure portion 12 which are formed integrally with each other in the vicinity of a nozzle portion of

the main body structure member 1. The nozzle structure portion 12 and the drive section structure member 3 are integrally fastened by means of bolts 6.

The drive section structure member 3 has in each of its separate sections a pairs of air supply holes 10 corresponding to the pair of bellows mated with the drive section structure member 3. Each bellows 2 has an air supply hole 13 (Fig. 4) which is positioned so as to be coaxial with the air supply hole 10. The drive section structure member 3 is divided into a plurality of structural elements 3a, 3b, 3c •••. Vertical and lateral slits 9a and 9b are formed between these adjacent structural elements. Thus, these independent structural elements constitute a plurality of drive sections.

If compressed air is supplied to each bellows 2 through the air supply hole 10, a force indicated by the arrow x_1 in Fig. 4 is produced between the main body structure member 1 and the drive section structure member 3 because the mechanical rigidity of the bellows in the axial direction is smaller than those of the other structural members. The force in the direction x_1 is transmitted as a moment to the elastically deformable portion 11. Since the mechanical rigidity of the elastically deformable portion 11 is smaller than those of the main body structure member 1 and the drive section structure member 3, the elastically deformable portion 11 is deformed in an elastic deformation manner, thereby moving the lip portion 14 in a direction x_2 (Fig. 5). The displacement δ thereby created is generally proportional to the moment transmitted from the bellows 2 or the compressed gas pressure that is the source of this moment. Fig. 6 shows an example of the displacement characteristic.

As described above, the lip opening can be controlled as desired by selecting the pressure of compressed gas supplied to the bellows. Furthermore, it is possible to control the lip opening at a plurality of positions simultaneously and independently by simultaneously and independently controlling the gas pressures supplied to the respective drive mechanisms.

If a portion of the lip portion is driven in the above-mentioned direction, other portions adjacent to the driven portion in the longitudinal direction are also displaced by interference. The multiplicity of slits 9a and 9b are provided to minimize the degree of this interference and, hence, the displacement due to the interference.

The present invention has been achieved in view of driving of T-die lip portions. However, it is also applicable to precision drive mechanism for precision various types of precision instruments including working machines, three-dimensional measuring apparatus, semiconductor manufacturing apparatus and the like.

In accordance with the present invention, the operation of each drive section is based on the expansion of the bellows and is therefore improved in the response. In the case of the ordinary thermal expansion type of drive unit, the time constant is about 10 to 20 minutes. In contrast, in accordance with the present invention, the time constant is 1 sec. or less.

The force of expansion of the bellows is transmitted from the drive section structure member to the nozzle structure member to control the elastic deformation of the nozzle portion. This system is substantially free from hysteresis and has a high driving resolution.

In the structure of divided drive sections, the degree of interference between adjacent drive sections is small.

It is possible for the divided drive sections to effect driving simultaneously at multiplicity of points as well as to effect driving without interference between adjacent drive sections, thus remarkably improving the drive controllability.

Claims

1. A lip drive structure for a T-die comprising:
a main body structure member having an elongated nozzle orifice defined by a pair of lip portion facing each other;
a nozzle structure portion including one of said lip portions and formed at the lower end of said main body structure member so as to be integrally connected to the same through an elastically deformable portion;
a plurality of bellows disposed on a side surface of said main body structure member on the side of said lip structure portion;
a drive section structure member fastened to said bellows at its upper portion and fastened to said nozzle structure portion at its lower portion; and
air supply holes formed in said drive section structure member to enable said bellows to be supplied with compressed air.

2. A lip drive structure for a T-die according to claim 1, wherein said drive section structural member is divided by split grooves into a plurality of elements in the longitudinal direction.

FIG. 1

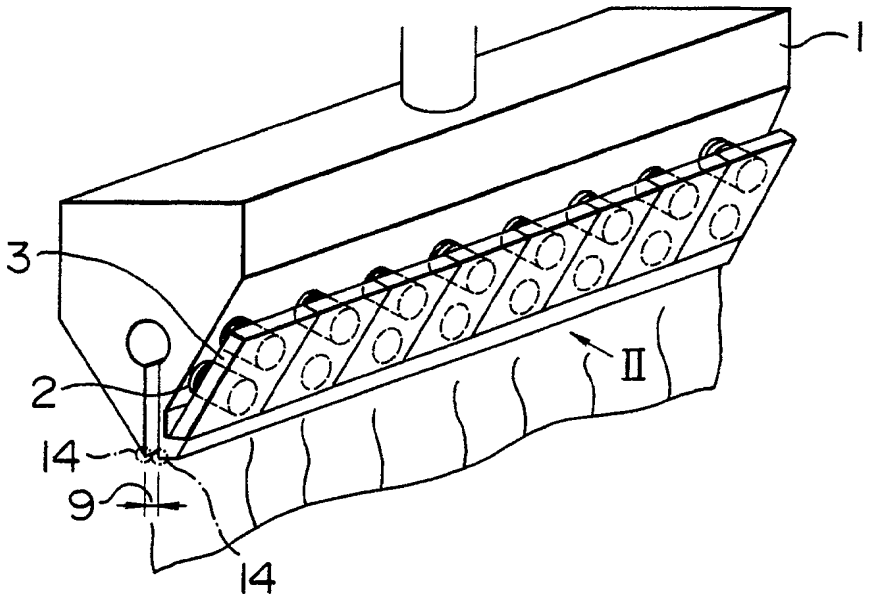


FIG. 2

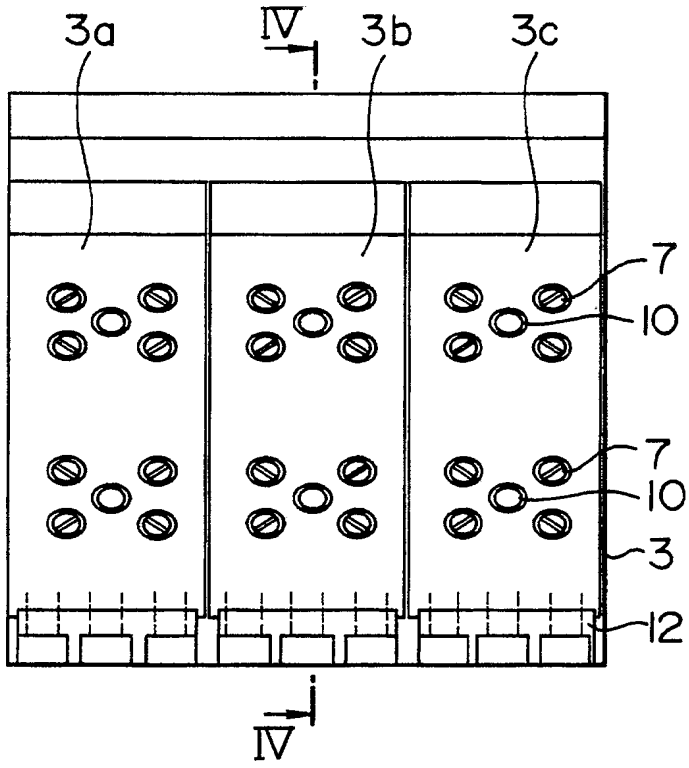


FIG. 3

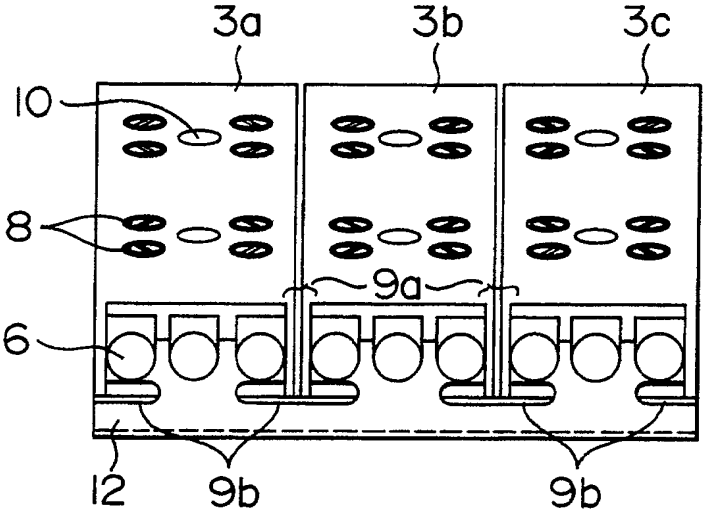

3a
3b
3c
10
8
9a
6
12
9b
9b

FIG. 4

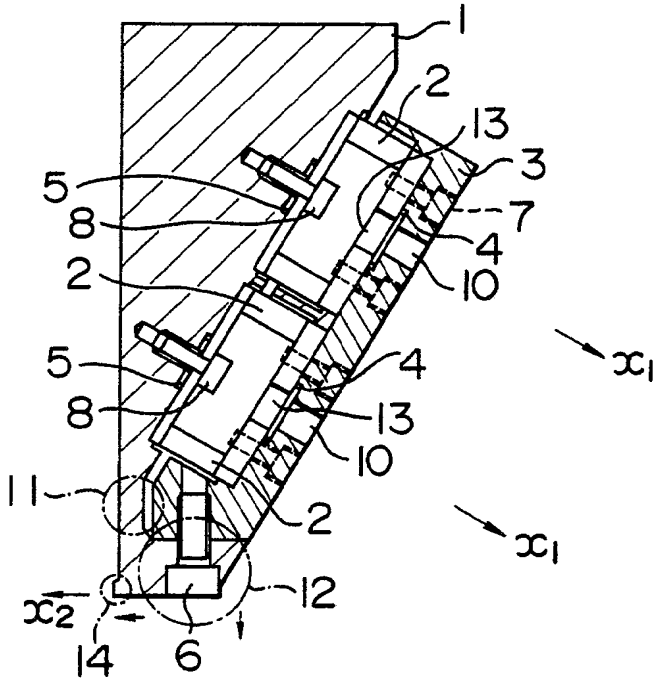

1
2
13
3
5
8
7
4
2
10
5
4
8
13
10
11
2
x1
x1
12
x2
14
6

FIG. 5

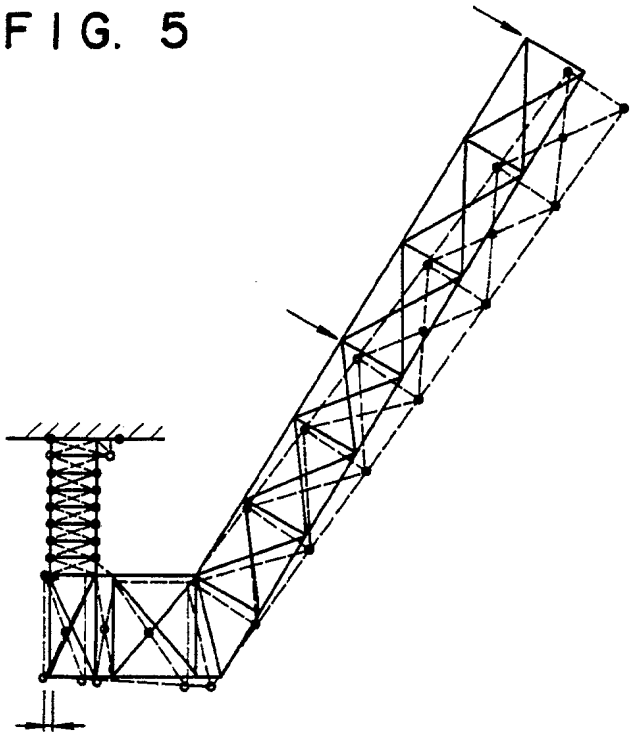
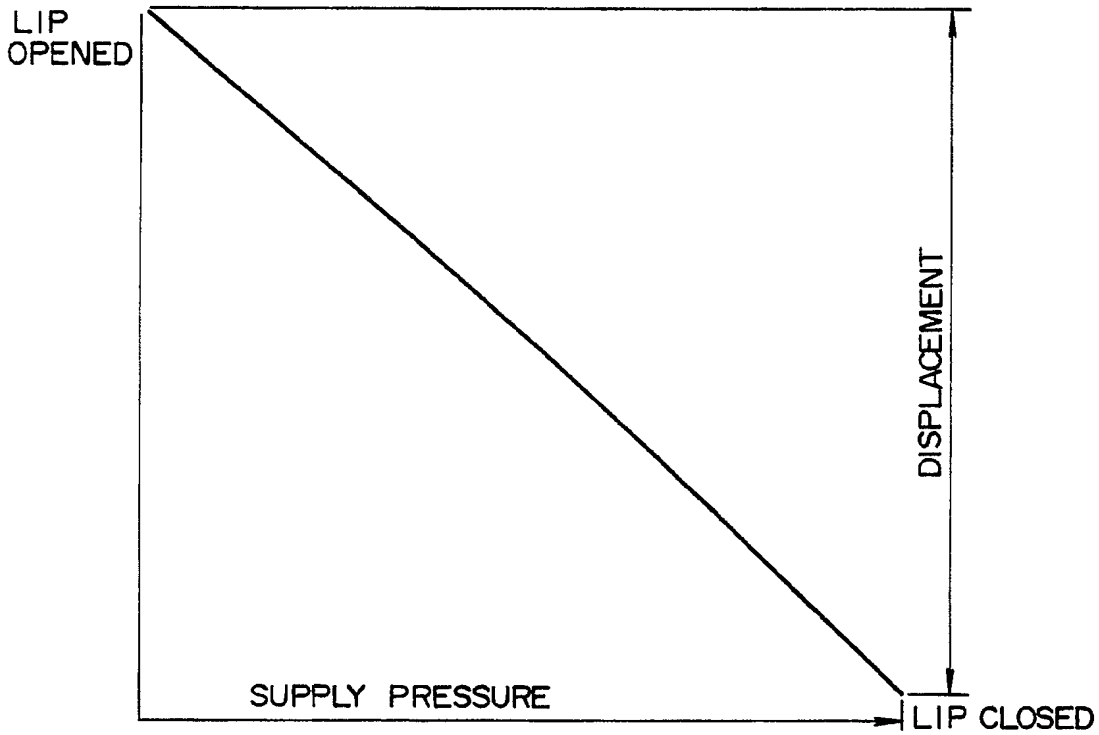


FIG. 6



SUPPLY PRESSURE-LIP DISPLACEMENT
STATIC CHARACTERISTIC

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 89 11 4757

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	PATENT ABSTRACTS OF JAPAN vol. 13, no. 265 (M-839)(3613) 19 June 1989, & JP-A-1 67325 (SUMITOMO HEAVY INDUSTRIES LTD) 14 March 1989, * the whole document *	1, 2	B05C5/02 B05C11/10 B29C47/16

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

B05C
B29C
D06B
B05B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	18 MARCH 1990	JUGUET J.M.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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